UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/643,638	08/18/2003	Peng Zhou	COOL-01500	4432

28960 7590 10/29/2007

HAVERSTOCK & OWENS LLP
162 N WOLFE ROAD
SUNNYVALE, CA 94086

EXAMINER	
PETTITT, JOHN F	
ART UNIT	**PAPER NUMBER**
3744	

MAIL DATE	DELIVERY MODE
10/29/2007	PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No.	Applicant(s)	
	10/643,638	ZHOU ET AL.	
	Examiner	Art Unit	
	/John Pettitt/	3744	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *04 June 2007*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-32* is/are pending in the application.

4a) Of the above claim(s) *8,14-19 and 22-25* is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-7, 9-13, 20-21, 26-32* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

DETAILED ACTION

Election/Restrictions

1. This application contains claims directed to the following patentably distinct species:

A. Wherein the reservoir is upstream of the at least one heat exchanger.

B. Wherein the reservoir is downstream of the at least one heat exchanger.

The species are independent or distinct because either the location of the reservoir is before or after the at least one heat exchanger relative to the direction of refrigerant flow.

Once the applicant elects either species A or B. The applicant is further required to elect between the following patentably distinct species:

C. Wherein the fluid is selected from a group consisting of water, acetonitrile, acetone, N-methylformamide, benzene, ethanol, methanol, and a combination thereof.

D. Wherein the fluid is a methane series halocarbon selected from the group consisting of trichlorofluoromethane and trifluoromethane.

E. Wherein the fluid is an ethane series halocarbon comprising pentafluoroethane (R-125).

F. Wherein the fluid is a zeotropic blend comprising R- 404A.

G. Wherein the fluid is an azeotropic blend selected from the group consisting of R-500 and R-502.

H. Wherein the fluid is inorganic selected from the group consisting of ammonia and carbon dioxide.

I. Wherein the fluid is a hydrocarbon selected from the group consisting of methane, ethane, propane, n-butane, 2-methylpropane, isobutane, ethene, ethylene, propene, propylene, and combinations thereof.

J. Wherein the fluid is a cryogenic fluid selected from the group consisting of hydrogen, parahydrogen, helium, nitrogen, neon, air, oxygen, argon, and combinations thereof.

The species are independent or distinct because either the fluid is one fluid or it is another.

Applicant is required under 35 U.S.C. 121 to elect a single disclosed species for prosecution on the merits to which the claims shall be restricted if no generic claim is finally held to be allowable. Currently, no claims are generic.

Applicant is advised that a reply to this requirement must include an identification of the species that is elected consonant with this requirement, and a listing of all claims readable thereon, including any claims subsequently added. An argument that a claim is allowable or that all claims are generic is considered nonresponsive unless accompanied by an election.

Upon the allowance of a generic claim, applicant will be entitled to consideration of claims to additional species which depend from or otherwise require all the limitations of an allowable generic claim as provided by 37 CFR 1.141. If claims are added after the election, applicant must indicate which are readable upon the elected species. MPEP § 809.02(a).

During a telephone conversation with Thomas Haverstack on August 23, 2007 a provisional election was made without traverse to prosecute the invention of species B and species H wherein the fluid is inorganic selected from the group consisting of ammonia and carbon dioxide, claims 1-7, 9-13, 20-21, and 26-32. Affirmation of this election must be made by applicant in replying to this Office action. Claims 8 and 14-19, 22-25 are withdrawn from further consideration by the examiner, 37 CFR 1.142(b), as being drawn to a non-elected invention.

Applicant is reminded that upon the cancellation of claims to a non-elected invention, the inventorship must be amended in compliance with 37 CFR 1.48(b) if one or more of the currently named inventors is no longer an inventor of at least one claim remaining in the application. Any amendment of inventorship must be accompanied by a request under 37 CFR 1.48(b) and by the fee required under 37 CFR 1.17(i).

Claim Objections

2. **Claims 1-7, 9-13, 20-21, and 26-32** are objected to because of the following informalities:

In regard to claim 1, the recitation, "wherein the fluid and gas" (lines 6-7) lack antecedent basis and the therefore, the recitation, "wherein the fluid and gas generated from boiling remain sealed within the cooling system" will be assumed to read --boiling the fluid to form a gas and a liquid, wherein the gas and the liquid remain sealed within the sealed cooling system--

In regard to claims 1 and 12, the recitation, "the system" (line 1) creates ambiguity since claim 1 recites "a cooling system" (claim 1, lines 1-2 and line 7) and "a sealed cooling system" (claim 1, line 3), therefore to remedy the deficiency, the stated claim 1 recitations will read --a sealed cooling system-- (lines 1-2 and 7) and --the sealed cooling system-- (line 3).

Appropriate correction is required.

Claim Rejections - 35 USC § 112

3. The following is a quotation of the first paragraph of 35 U.S.C. 112:

> The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

4. **Claim 3** is rejected under 35 U.S.C. 112, first paragraph, as failing to comply with the written description requirement. The claim(s) contains subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor(s), at the time the application was filed, had possession of the claimed invention.

The applicant distinctly discloses two methods of cooling a heat generating device in Figures 4A and 4B as well as 7A and 7B. In these methods, a pump is used to cause a fluid to flow in a heat exchanger (steps 400, 450, 700, 750) and then either the operation of the pump is adjusted (410, 710) or an orifice is adjusted (460, 760). Throughout the specification, the applicant discloses the methods as alternatives (page 11, lines 5-10; page 12, lines 5-10; page 8, lines 1-7; page 11, line 24 - page 12, line 4). Therefore, the applicant clearly has combined the two alternative methods discussed

above into one new embodiment in claim 3 where the operation of the pump is adjusted (claim 1, lines 8-9) and an orifice is adjusted (claim 3, line 2). The examiner also notes that the applicant does not disclose how this method would be carried out; whether the pump adjustment would take place followed by the orifice adjustment or vice versa or if both were simultaneously adjusted; therefore, claim 3 represents new matter.

5. The following is a quotation of the second paragraph of 35 U.S.C. 112:

> The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

6. **Claims 5-11** are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

In regard to claim 5, the recitation, "a larger volume" (line 2) requires some comparison to another volume not recited and unclear from the specification. The examiner is unable to determine what the reservoir's volume should be greater than. Therefore the examiner assumes the recitation to read --a volume--.

In regard to claim 21, the recitation, "wherein the inorganic is selected from the group consisting of ammonia and carbon dioxide" (lines 1-2) is indefinite as the examiner finds that the broadest reasonable interpretation of inorganic is 'those substances not containing carbon', therefore, carbon dioxide would be excluded from such a class. The examiner understands that it is known in the art for carbon monoxide and carbon dioxide to be considered inorganic despite the definition (considered exceptions). However, for the purpose of examination, it is considered expedient to

employ the most concise wording and definitions, therefore, the examiner will presume, that claim 21 reads --The method of claim 1, wherein the fluid is selected from the group consisting of ammonia and carbon dioxide--.

Claim Rejections - 35 USC § 102

7. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.
>
> (e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

8. **Claims 1, 4-7, 9-11, and 31-32** are rejected under 35 U.S.C. 102(e) as being anticipated by Tilton (US 2004/0089008 A1) hereafter Tilton.

In regard to claim 1, Tilton teaches a method of cooling at least one heat-generating device (12) using a sealed cooling system (10; interpreted as a closed cycle, wherein the refrigerant is substantially closed from the environment), the method comprising the steps of: using at least one pump (40) to cause a fluid (coolant) to flow in a sealed cooling system (10) including at least one heat exchanger (50); and adjusting a pressure of the flowing fluid (paragraph 77) to correspondingly adjust a boiling point temperature of the fluid in the at least one heat exchanger (50; inherent to changing the pressure - the relationship between the temperature and pressure is an inherent

property of a refrigerant and if one changes the pressure the saturation temperature will inherently be adjusted or changed), boiling the fluid to form a gas and a liquid (paragraph 65 - when coolant is sprayed onto hot semiconductor, coolant becomes two-phase or boils creating both gas and liquid), wherein the gas and the liquid remain sealed within the sealed cooling system (the coolant is re-circulated and both phases are retained within the cooling system 10; see Figures); wherein the pressure of the flowing fluid is adjusted by adjusting an operating condition of the pump (paragraph 77) in response to a changed property of the heat-generating device or the cooling system (controller responds to pressure and temperature of the fluid and maintains such to provide sufficient cooling; additionally pump adjusts pressure and flow rate in response to changed control signals of the controller which would represent a changed property of the cooling system).

In regard to claim 4, Tilton teaches providing at least one heat rejector (condenser 30) for rejecting heat from the system to ambient air (paragraph), the at least one heat rejector (30) being situated downstream of the at least one heat exchanger (see Figures; X is downstream of Y is interpreted as X is after Y with relation to the flow direction of the fluid).

In regard to claim 5, Tilton teaches providing a reservoir (25) that accommodates a volume of the gas in the system generated during boiling (reservoir 25 has a volume and is fluidly connected to the spray module 50, therefore the reservoir inherently accommodates - has room for - the gas generated in 50).

In regard to claim 6, Tilton teaches that the reservoir (25) reduces a change in pressure of the fluid that occurs during boiling (the volume of the reservoir inherently reduces increases in pressure due to boiling since the volume available for the gas is increased by the volume of the reservoir; additionally, paragraph 53 explicitly teaches that the reservoir reduces pressure variations during high vapor production).

In regard to claim 7, Tilton teaches that the reservoir (25) is situated downstream of the at least one heat rejector (30) (see Figure 2).

In regard to claim 9, Tilton teaches that the reservoir (25) reduces a change in pressure of the fluid that occurs during boiling (the volume of the reservoir inherently reduces increases in pressure due to boiling since the volume available for the gas is increased by the volume of the reservoir; additionally, paragraph 53 explicitly teaches that the reservoir reduces pressure variations during high vapor production).

In regard to claim 10, Tilton teaches that the reservoir (25) having an inlet (received on top in figure 2) coupled to a fluid outlet port (shown on right side of 30) of the at least one heat rejector (30) via a first portion (portion between 30 and 25) of a fluid transport line (line between 25 and 30 and 40) and an outlet (on left side of reservoir 25) coupled to a fluid inlet port (shown received at bottom part of pump 40) of the at least one pump (40) via a second portion (portion between 40 and 25) of the fluid transport line.

In regard to claim 11, Tilton teaches that the reservoir (25) is integrated with (interpreted as connected with) the at least one heat rejector (30) and the at least one pump (40; lines between components connect the reservoir heat rejector and pump -

Figure 2; in addition Figure 3 teaches that the heat rejector 30, reservoir 25, and pump 40 are also connected with one another).

In regard to claim 31, Tilton teaches that the step of adjusting a pressure of the fluid comprises adjusting the pressure of the fluid during a charging and sealing of the system (paragraph 79; the pressure of the refrigerant is inherently based on the amount of fluid provided to the cooling system; as refrigerant is stored into the cooling system the pressure of the fluid will inherently be adjusted or changed as it flows from a source to the cooling system).

In regard to claim 32, Tilton teaches that the step of adjusting a pressure of the fluid comprises adjusting a composition and volume and combinations thereof a gas and liquid and combinations thereof introduced during charging of the system (paragraph 79).

9. Claims 1-3, 12, 27-28, and 31-32 are rejected under 35 U.S.C. 102(e) as being anticipated by Cader et al. (US 6,836,131) hereafter Cader.

In regard to claim 1, Cader teaches a method of cooling at least one heat-generating device (DUT - column 1, lines 50-55, 60) using a sealed cooling system (Figures 6 and 8), the method comprising the steps of: using at least one pump (665, 680, 865, 890) to cause a fluid (coolant) to flow in the sealed cooling system including at least one heat exchanger (spray chamber); and adjusting a pressure of the flowing fluid (column 9, lines 25-30) to correspondingly adjust a boiling point temperature of the fluid in the at least one heat exchanger (spray chamber; inherent to changing the pressure -

the relationship between the temperature and pressure is an inherent property of a refrigerant and if one changes the pressure the saturation temperature will inherently be adjusted or changed; also expressly taught - column 9, lines 20-25), boiling the fluid to form a gas and a liquid (column 8, lines 35-40; column 9, lines 35-40- when coolant is sprayed onto hot electrical device DUT, coolant becomes two-phase or boils creating both gas and liquid), wherein the gas and the liquid remain sealed within the sealed cooling system (the coolant is re-circulated and both phases are retained within the cooling system, column 8, lines 60-67); wherein the pressure of the flowing fluid is adjusted by adjusting an operating condition of the pump (column 9, lines 25-30) in response to a changed property (coolant pressure-column 9, line 27 and temperature 640- column 9, line 37; column 9, line 10 - temperature of the heat generating device - DUT; and temperature of the heat exchanger - spray chamber - 645 - column 9, line 37) of the heat-generating device or the cooling system.

In regard to claim 2, see claim 1.

In regard to claim 3, Cader teaches the step of adjusting a pressure of the fluid comprises adjusting an orifice (making changes to the sizes and number of the spray nozzles - column 10, lines 25-30) coupled to the at least one heat exchanger (spray chamber) in response to: changes in temperature of the fluid (column 10, lines 25-30; and thereby inherently changing the pressure within the chamber; in response to the temperature of fluid when operating with different sized and numbered spray nozzles).

In regard to claim 12, Cader teaches that the system is hermetically sealed (interpreted as sealed such that air may not trespass, column 10, lines 47-48; column 8, lines 60-67).

In regard to claim 27, Cader teaches providing sensors (620, 640, 645, 822, 845) to adjust the fluid flow from the at least one pump (865, 665; column 9, line 25-35; column 10, lines 55-60)

In regard to claim 28, Cader teaches that the sensor (645 or 620) are coupled to the at least one heat exchanger (spray chamber).

In regard to claim 31, Cader teaches that the step of adjusting a pressure of the fluid comprises adjusting the pressure of the fluid during a charging and sealing of the system (column 8, lines 60-67; the pressure of the refrigerant is inherently based on the amount of fluid provided to the cooling system; as refrigerant is stored into the cooling system the pressure of the fluid will inherently be adjusted or changed as it flows from a source to the cooling system).

In regard to claim 32, Cader teaches that the step of adjusting a pressure of the fluid comprises adjusting a composition (column 8, lines 50, 56) introduced during charging of the system.

10. Claims 1, 20, and 26-32 are rejected under 35 U.S.C. 102(b) as being anticipated by Jiang ("Closed-Loop Electroosmotic Microchannel Cooling System for VLSI") hereafter Jiang.

In regard to claim 1, Jiang teaches a method of cooling at least one heat-generating device (IC Chip) using a sealed cooling system (Fig. 1), the method comprising the steps of: using at least one pump (electro-osmotic pump) to cause a fluid (refrigerant-water) to flow in the sealed cooling system including at least one heat exchanger (two-phase microchannel heat exchanger); and adjusting a pressure of the flowing fluid (pump adjusts pressure of fluid - page 9 last paragraph) to correspondingly adjust a boiling point temperature of the fluid (such pressure adjustment by pump inherently changes the saturation temperature of the fluid) in the at least one heat exchanger (two-phase microchannel heat exchanger), boiling the fluid to form a gas and a liquid (heating the refrigerant and forming the vapor and liquid), wherein the gas and the liquid remain sealed within the sealed cooling system (page 9, 2nd paragraph-closed system); wherein the pressure of the flowing fluid is adjusted by adjusting an operating condition of the pump (pump power is adjusted-Figure 12) in response to a changed property (temperature of chip) of the heat-generating device or the cooling system (in order to obtain the performance operating curves shown in Fig. 12).

In regard to claim 20, Jiang teaches that the fluid is an inorganic (interpreted as anything not containing carbon; water).

In regard to claim 26, Jiang teaches water (page 9 under closed loop system performance).

In regard to claim 27, Jiang teaches providing sensors (temperature and pressure sensors - page 9 under section 4) to adjust the fluid flow from the at least one pump (electro-osmotic pump).

In regard to claim 28, Jiang teaches that the sensor (pressure, temperature, flow rate; p.9) are coupled to the at least one heat exchanger (two-phase microchannel heat exchanger).

In regard to claim 29, see claim 1.

In regard to claim 30, Jiang teaches delivering to a catalytic recombiner (recombiner-page 23 and page 8-electro-osmotic pump) a gaseous stream containing hydrogen being discharged from a downstream side of the at least one pump (electro-osmotic pump) together with an amount of oxygen generated from an upstream side of the at least one pump (electro-osmotic pump) sufficient to convert the hydrogen and oxygen to water, the catalytic recombiner coupled to an inlet port of the at least one pump (see figure 8 - recombiner is coupled to overall structure of pump and near inlet; Further statement on page 9, lines 1-2 that recombiner recombines the gas generated during electrolysis-inherently teaches the combination of oxygen and hydrogen from all locations where these components are generated).

In regard to claim 31, Jiang teaches that the step of adjusting a pressure of the fluid comprises adjusting the pressure of the fluid during a charging and sealing of the system (the pressure of the refrigerant is inherently based on the amount of fluid provided to the cooling system; as refrigerant is stored into the cooling system the pressure of the fluid will inherently be adjusted or changed as it flows from a source to the cooling system).

In regard to claim 32, Jiang teaches that the step of adjusting a pressure of the fluid comprises adjusting a (volume; page 9) introduced during charging of the system

(the pressure developed by the pump is inherently dependent on the amount and type of coolant charged in the system).

10. Claims 1, 20, and 26-32 are rejected under 35 U.S.C. 102(b) as being anticipated by Koo.

In regard to claim 1, Koo teaches a method of cooling at least one heat-generating device (IC Chip) using a sealed cooling system (Fig. 1), the method comprising the steps of: using at least one pump (electro-kinetic pump) to cause a fluid (refrigerant-water) to flow in the sealed cooling system including at least one heat exchanger (microchannel heat exchanger); and adjusting a pressure of the flowing fluid (pump adjusts pressure of fluid - page 426 in order to obtain the data) to correspondingly adjust a boiling point temperature of the fluid (such pressure adjustment by pump inherently changes the saturation temperature of the fluid) in the at least one heat exchanger (microchannel heat exchanger), boiling the fluid to form a gas and a liquid (heating the refrigerant and forming the vapor and liquid - p. 425, second column), wherein the gas and the liquid remain sealed within the sealed cooling system (inherent to closed system); wherein the pressure of the flowing fluid is adjusted by adjusting an operating condition of the pump (pump power is adjusted-Figure 5) in response to a changed property (temperature of chip - as per experiment being performed by authors) of the heat-generating device (chip) or the cooling system (in order to obtain the performance operating curves shown in Fig. 5-6).

In regard to claim 20, Koo teaches that the fluid is an inorganic (interpreted as anything not containing carbon; water).

In regard to claim 26, Koo teaches water (page 426 under conclusion).

In regard to claim 27, Koo teaches providing sensors (temperature and pressure sensors - inherent to obtaining data in Fig. 5-6) to adjust the fluid flow from the at least one pump (electro-kinetic pump).

In regard to claim 28, Koo teaches that the sensor (pressure, temperature, and flow rate, p. 426) are coupled to the at least one heat exchanger (microchannel heat exchanger).

In regard to claim 31, Koo teaches that the step of adjusting a pressure of the fluid comprises adjusting the pressure of the fluid during a charging and sealing of the system (the pressure of the refrigerant during operation is inherently based on the amount of fluid provided to the cooling system; as refrigerant is stored into the cooling system the pressure of the fluid will inherently be adjusted or changed as it flows from a source to the cooling system).

In regard to claim 32, Koo teaches that the step of adjusting a pressure of the fluid comprises adjusting a volume (p. 426) introduced during charging of the system (the pressure developed by the pump is inherently dependent on the amount and type of coolant charged in the system).

Claim Rejections - 35 USC § 103

11. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

12. The factual inquiries set forth in *Graham* **v.** *John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.
2. Ascertaining the differences between the prior art and the claims at issue.
3. Resolving the level of ordinary skill in the pertinent art.
4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

13. **Claim 13** is rejected under 35 U.S.C. 103(a) as being unpatentable over the obvious modification of Cader. Cader teaches all the limitations of claim 13 but does not explicitly teach that the sealed system of Cader is capable of preventing a change in the pressure under a given set of pump, ambient temperature, and heating conditions varies by less than 1 psi during a five year lifetime. However, Cader teaches that the cooling system is sealed and that the pressures within the system may be maintained at

above and below atmospheric pressures. It is old in the art to make cooling systems hermetic. Further, basic domestic refrigeration systems are routinely designed and fabricated to avoid leaking any refrigerant (including an amount that would result in a system pressure drop of 1 psi) over a period of 5 years and longer. Therefore, it would have been obvious to one of ordinary skill in the art, at the time the invention was made, to ensure that the system components could maintain the sealed nature of the system for greater than 5 years.

14. **Claim 21** is rejected under 35 U.S.C. 103(a) as being unpatentable over Jiang in view of Chordia (US 2004/0250994) hereafter Chordia. Jiang teaches all the limitations of claim 1 but does not teach using carbon dioxide. Chordia teaches the use of carbon dioxide as a suitable coolant for microdevices. Therefore, it would have been obvious to one of ordinary skill in the art, at the time the invention was made, to employ carbon dioxide as the coolant within the electro-osmotic pumping system of Jiang for the purpose of providing a super-critical refrigerant (paragraph 21, 9) for the purpose of obtaining low viscosity of the fluid and hence low resistance to fluid flow, making it possible to pump more fluid for a given power or pumping the same amount of fluid for less power, thus improving system performance.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to /John Pettitt/ whose telephone number is 571-272-0771. The examiner can normally be reached on M-F 8a-4p.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Cheryl Tyler can be reached on 571-272-4834. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/John Pettitt/
Examiner
Art Unit 3744
JFP III
August 24, 2007

FRANTZ JULES
SUPERVISORY PATENT EXAMINER